Hot-Dip Galvanized Steel Bridge Preservation

An overview on the performance, specification, design, fabrication, construction and inspection of hot-dip galvanized steel bridges.

Presenter Information, Event Name & Date

galvanizeit.org

PROTECT STEEL BRIDGES WITH HOT-DIP GALVANIZING

LOW LIFE-CYCLE COST | DURABILITY | SUSTAINABILITY

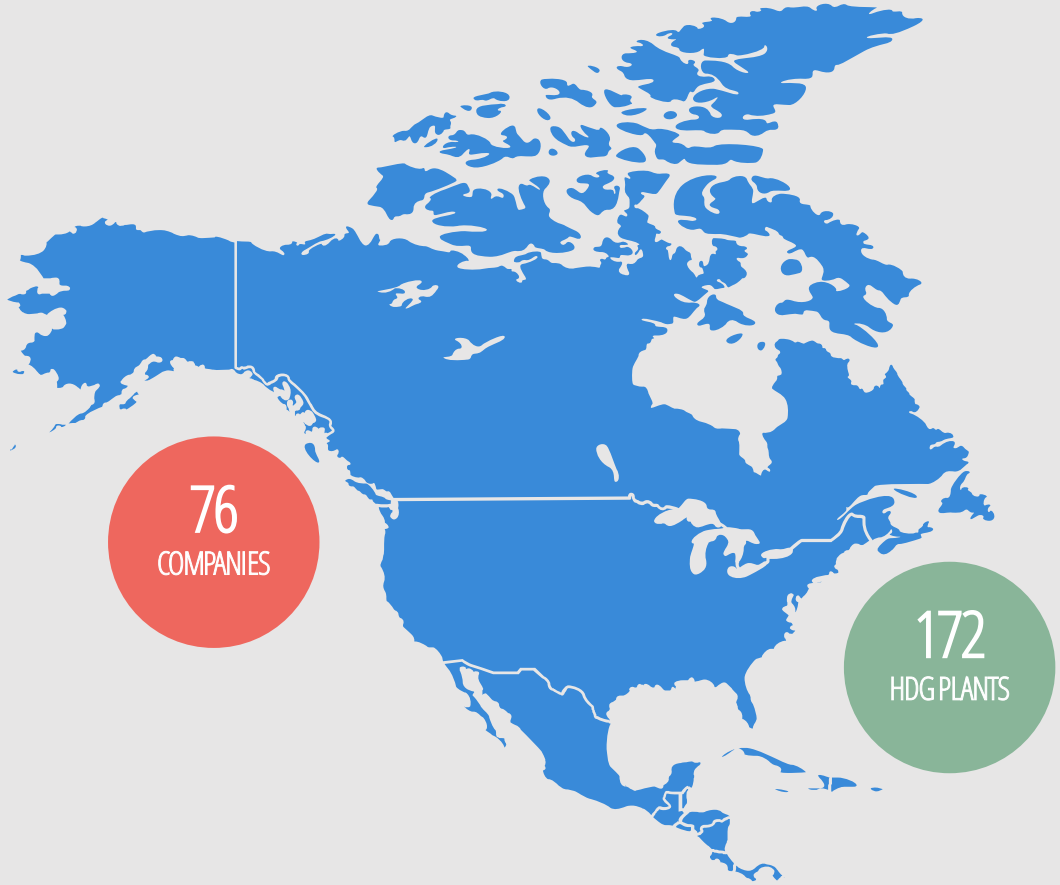
USACE FORT WINGATE BRIDGE REPLACEMENT

Gallup, NM | 2022

52 tons – Press-brake-formed steel tub girder: 8 beams weighing 12,600 lbs. each

About the American Galvanizers Association (AGA)

Non-profit trade organization established in 1933



AGA™
American Galvanizers Association
Protecting Steel for a Sustainable Future
Zn

Technical

The AGA provides technical support on the performance, design, inspection and specification of HDG steel

Marketing

The AGA provides its members with sales & marketing support and serves as the unified voice of the industry

Specifiers

The AGA is a free resource to North American specifiers and provides guidance on specifying HDG steel

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LOW LIFE-CYCLE COST

- Enables 100-year bridge design for sustainable infrastructure
- Proven history in bridge applications

SUSTAINABILITY

- Zinc and steel are naturally occurring, abundant elements
- Both are 100% recyclable w/o loss in properties

DURABILITY

- Durable, economical corrosion protection with minimal upkeep
- Suitable for most bridge applications: superstructure, substructure, reinforcing steel, buried structures, sign structures, guardrail, etc.

TURNAROUND TIME

- → Factory-controlled
- → No humidity requirements or curing
- → Optimizations available to improve turnaround

AVAILBILITY

- → 180+ hot-dip galvanizing plants in North America
- → Average kettle size: 40 ft long, 8 ft deep, 6 ft wide
- → Variety of products from fasteners to large structural members

AESTHETICS

- → Natural gray finish that blends seamlessly into its surroundings
- → Weathers to a neutral, non-reflective, matte gray patina
- → Duplex system (HDG + paint) offers endless aesthetic options

AGA TOOLS & RESOURCES

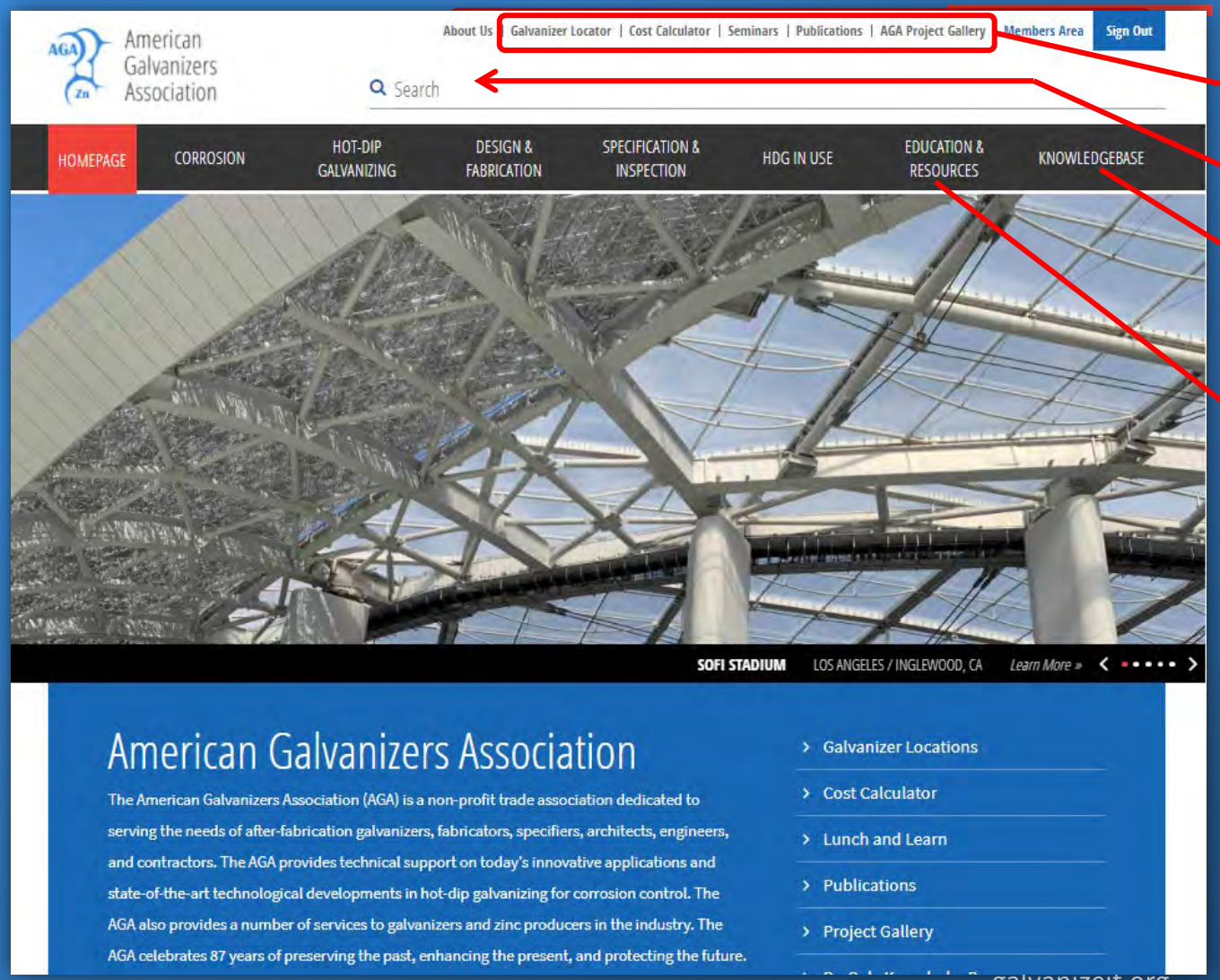
ESSENTIAL RESOURCES FOR SPECIFYING HOT-DIP GALVANIZED STEEL

OGDENSBURG-PRESCOTT BRIDGE REHAB

Ogdensburg, NY | 2021

442 tons – Main span bridge decking, structural steel floor beams and stingers

Website - Galvanizeit.org



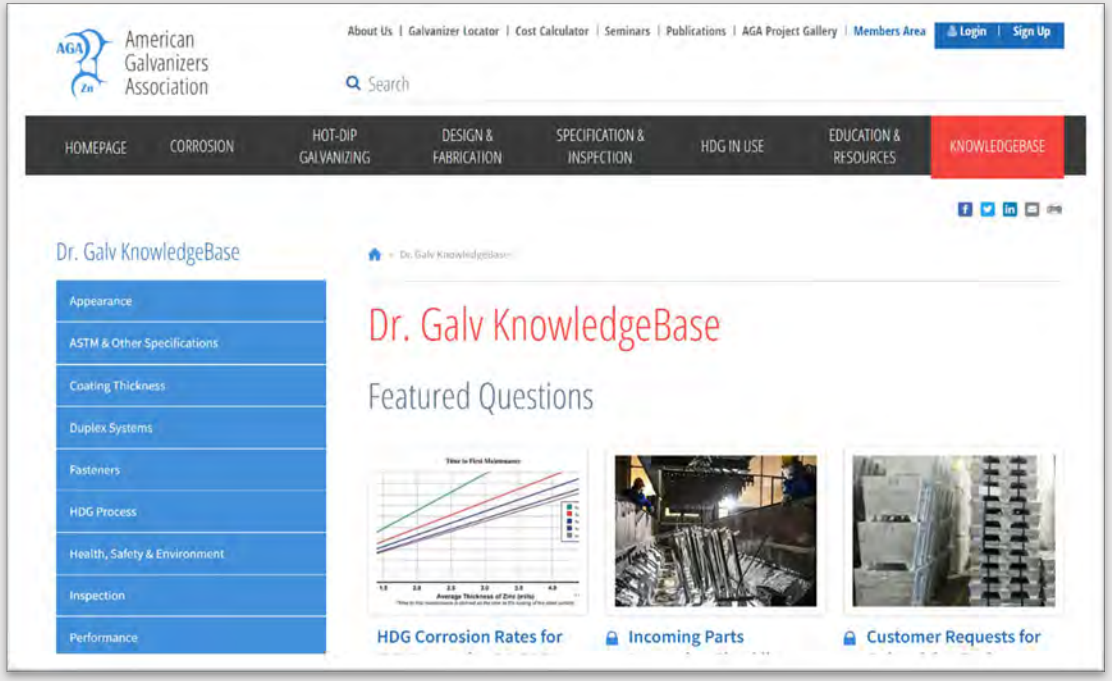
Tools & AGA Resources

Robust Search Function

Knowledgebase

Education & Resources

Dr. Galv” Knowledgebase

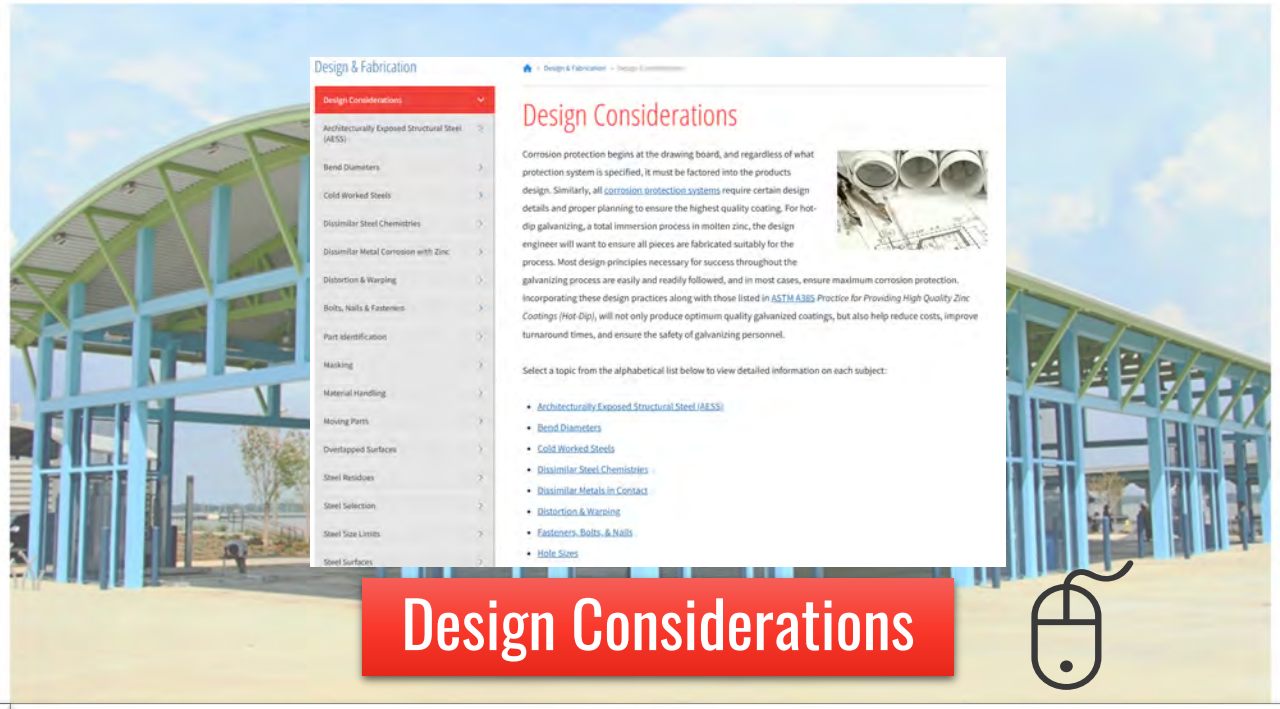


- More than 400 short form Q&A articles
  - Organized by category
  - Visible using search function
  - Some are member protected
    - HDG Process
    - Environmental Health & Safety
- Designed to answer specific FAQs about anything galvanizing
- Technical expertise tailored to galvanizers

Technical Expertise

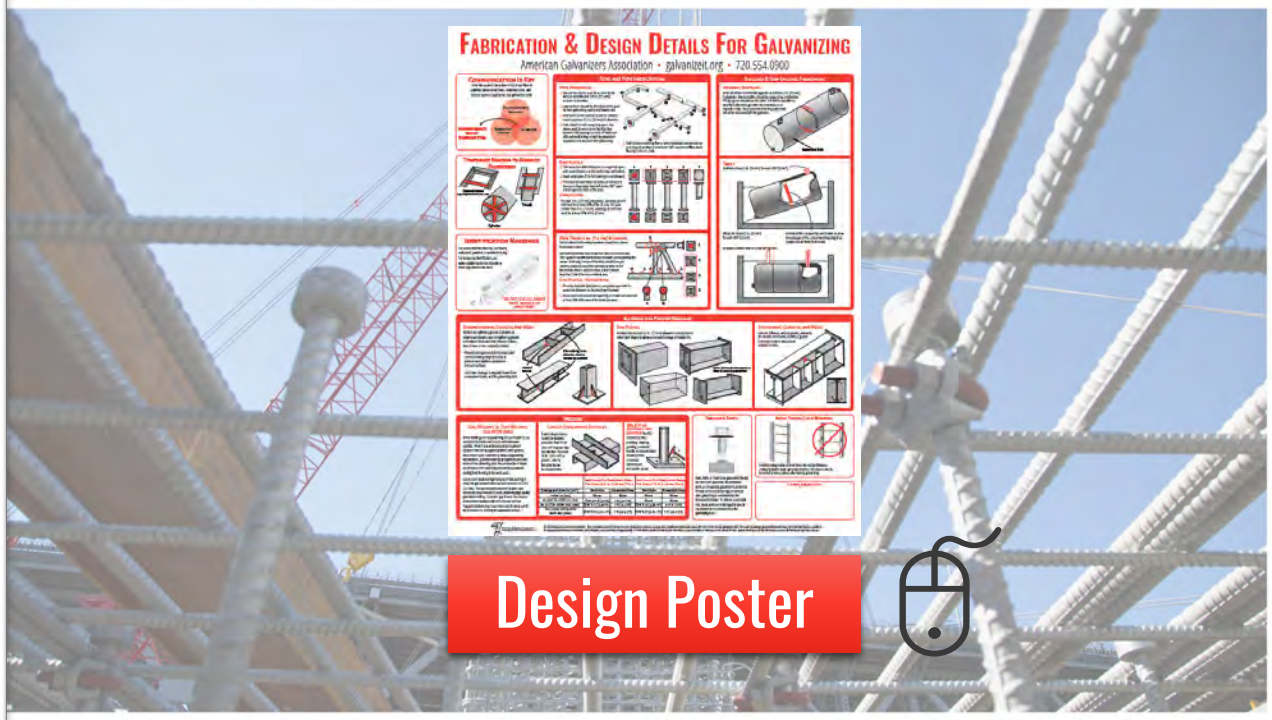
- Dedicated Process, Coating, Performance, Health& Safety staff
  - address all questions—serious or silly—with professionalism, expertise, and access to an extensive technical library.
- Members & Specifiers call/email for help with specifications, calculations, conversions, or any technical concerns.
- If the AGA doesn't have an immediate answer, they will either connect with the right experts or explore the issue as a potential research topic.

Knowledgebase
Design & Fabrication



Design Considerations

Design Guide



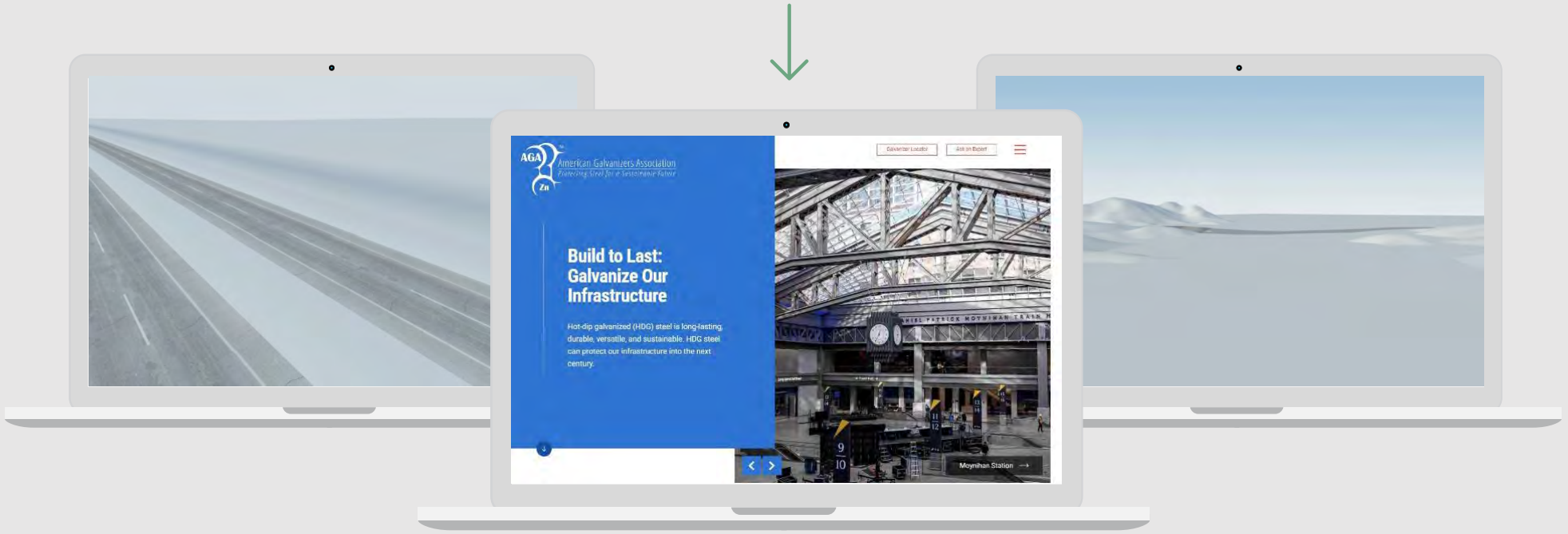
Design Poster

HDG Markets & Products Website

https://markets.galvanizeit.org

- → Website Highlighting HDG Projects & Technical Info
- → Organized by Market/Product Type & State/Provinces
- → Animations Highlight the Various Uses of HDG Steel

Visit Website



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HDG Components in Bridges & Highways

markets.galvanizeit.org

“Galvaniz-able” Steel Bridge Components

Nearly all steel components on a bridge can be hot-dip galvanized to maximize longevity

Superstructure

- Base Plates
- Beams
- Bearing Plates
- Cables
- Cross-Bracing
- Diaphragms
- Expansion Joints
- Girders
- Splice Plates
- Trusses

Substructure

- Abutments
- Anchor Bolts
- Buried Bridges
- Dams
- Ground Anchors
- H Piling
- Pile/Pier Caps
- Pier Pilings
- Sheet Piling
- Wing walls

Decking

- Curb Angles
- Drainage Supports/ Systems
- Floor Grating
- Flooring Grid
- Reinforced Wire Mesh
- Reinforcing Steel
- Scuppers & Drains

Ancillary

- Box Rails
- Catwalks
- Fasteners
- Barriers
- Ladders
- Light Poles
- Piping
- Sign Supports

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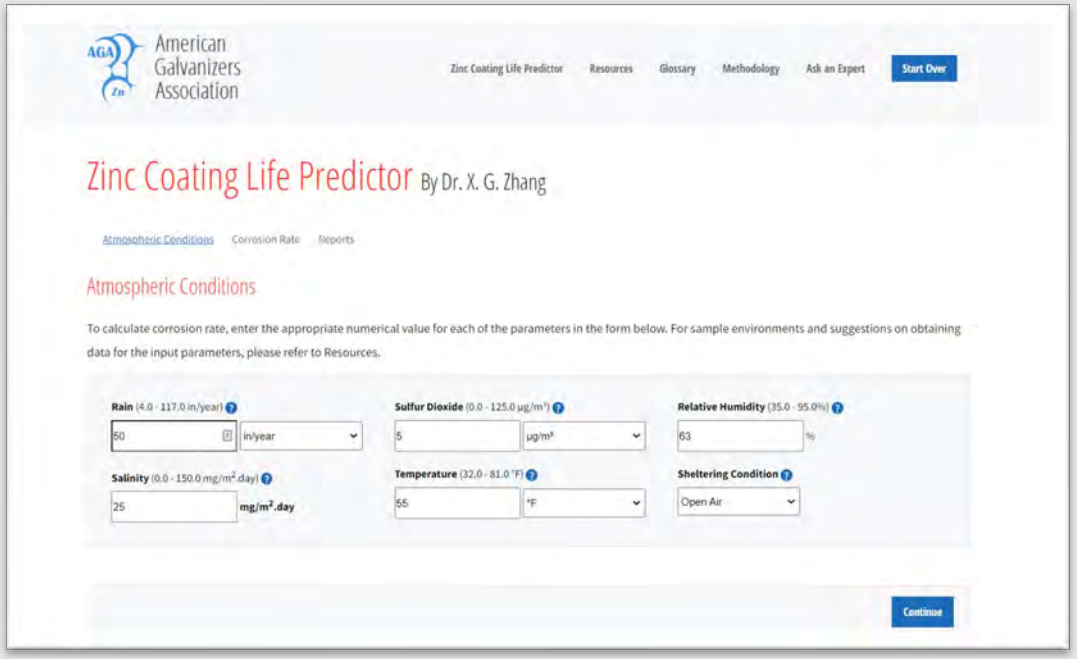
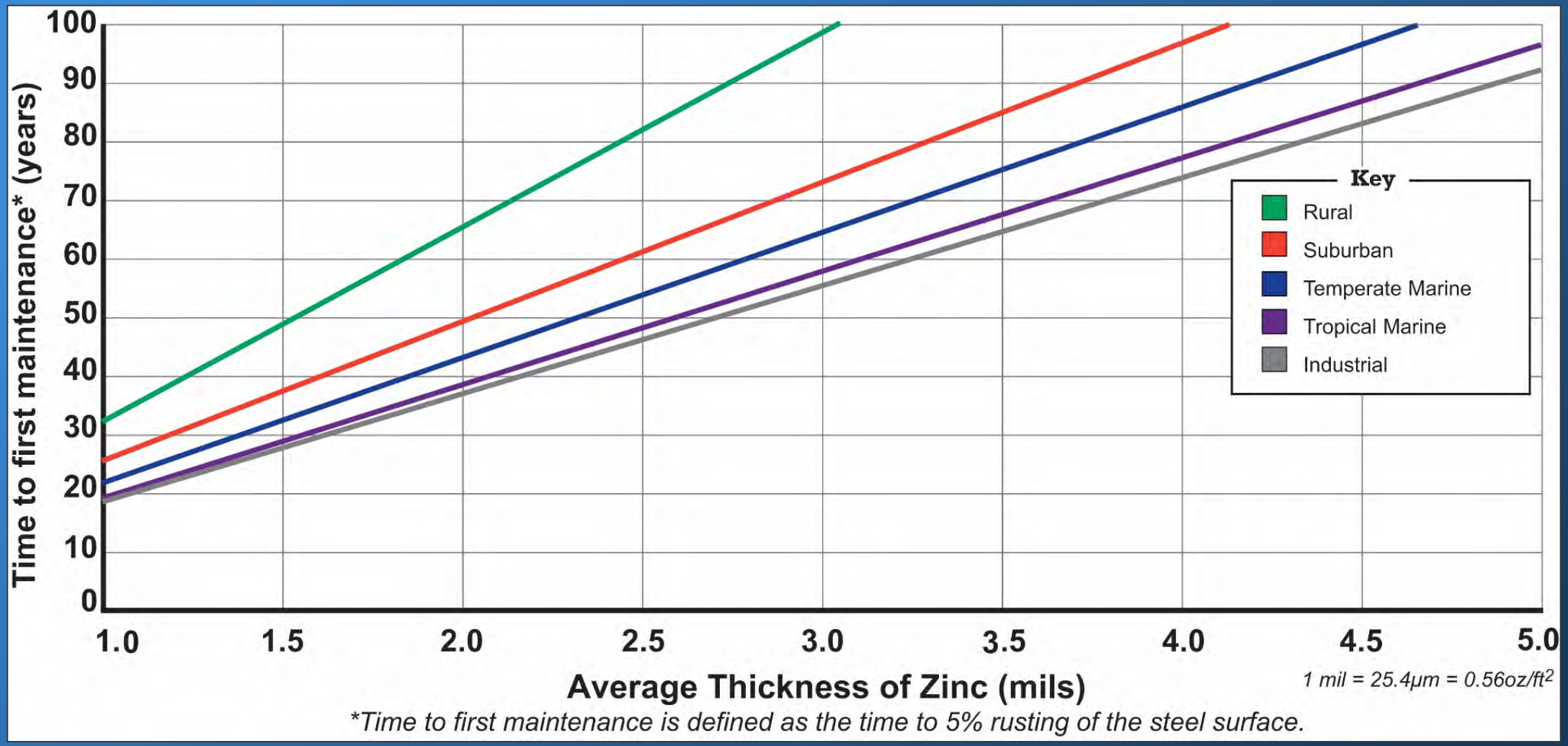
Zinc Coating Life Predictor

- Estimate the corrosion rate of zinc (galvanized) in various environments
  - Statistical Methods
  - Neural Network Technology
  - Extensive Worldwide Corrosion Database
- Users Guide w/ Links to Collect Local Data
  - https://galvanizeit.org/knowledgebase/article/the-zinc-coating-life-predictor
- Used to develop our Time-to-First Maintenance Chart
- **ZCLP.galvanizeit.org**



Time to First Maintenance Chart



Soil Charts

Evaluate Chloride Concentration

> 20 PPM use Charts 1 & 2

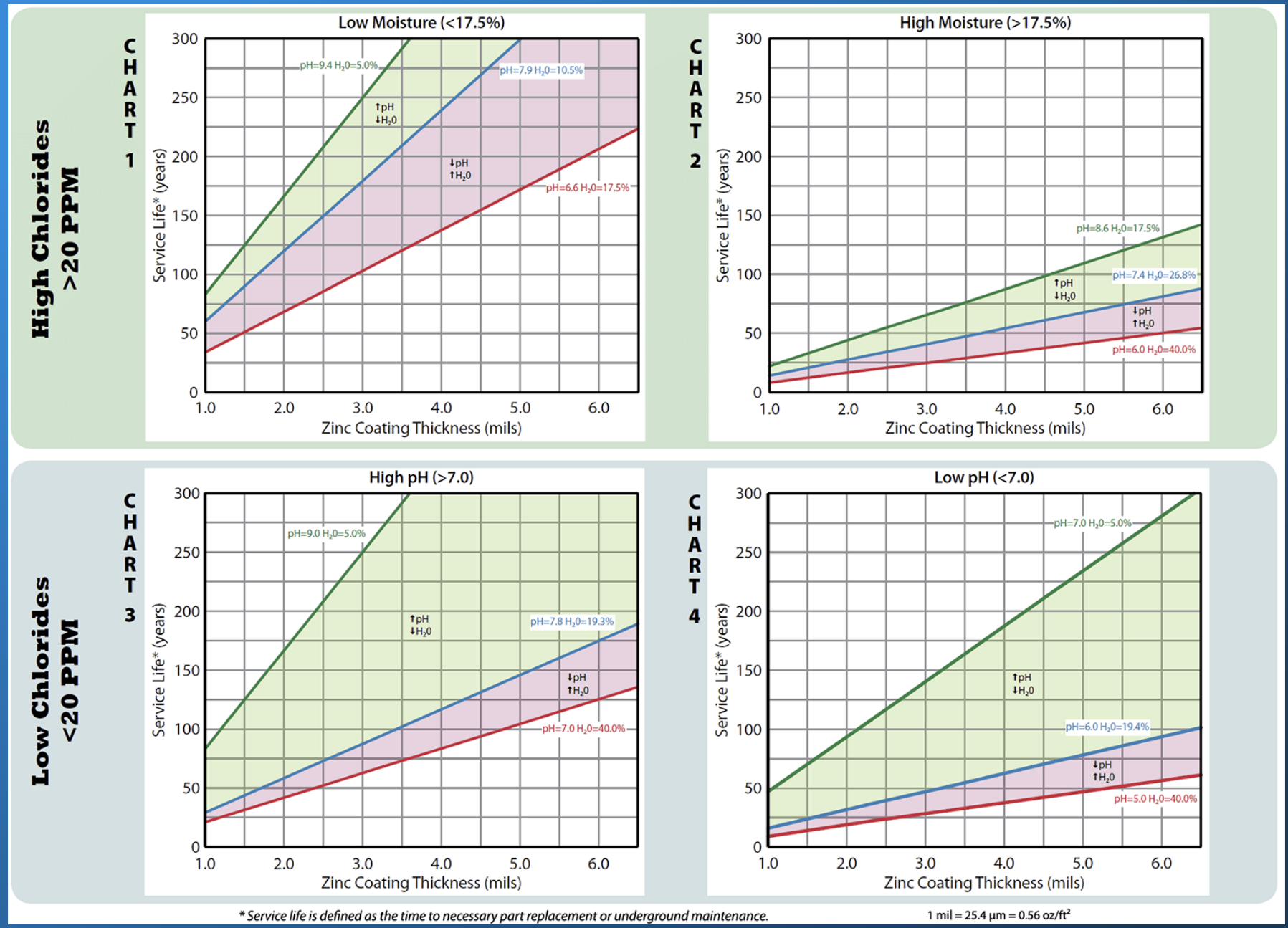
- Evaluate Moisture Content
- Evaluate pH

< 20 PPM use charts 3 & 4

- Evaluate pH
- Evaluate Moisture Content

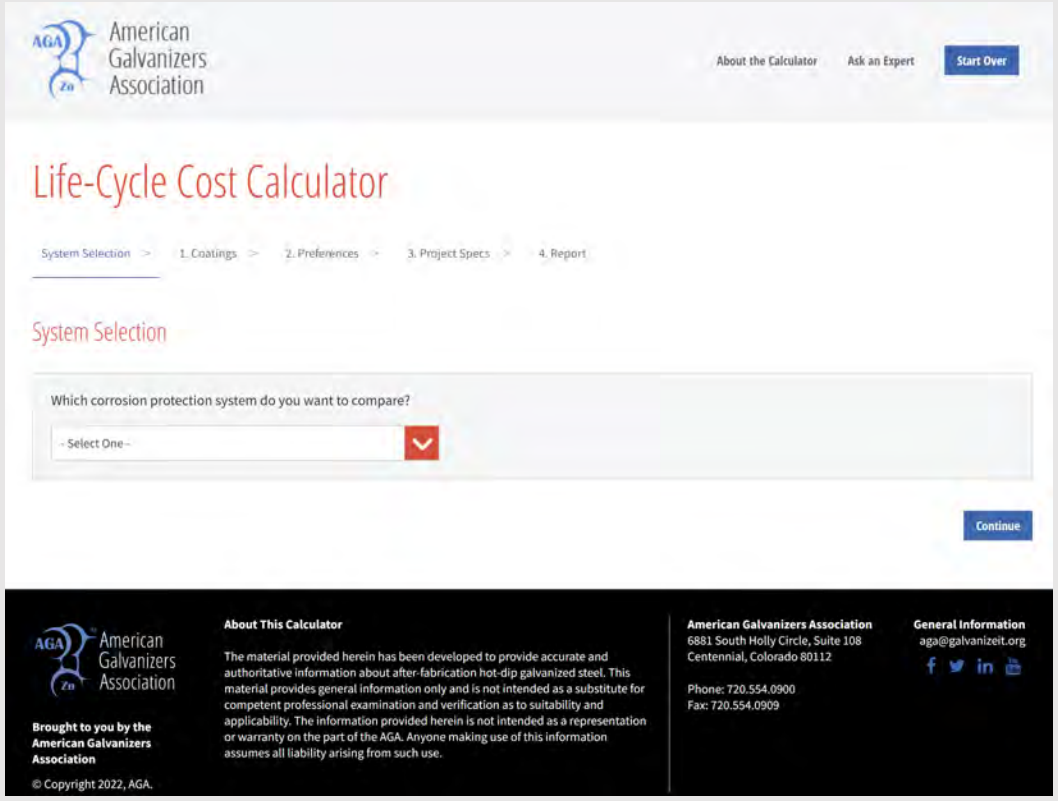
*NOTE: Service life is defined as the time to necessary part replacement (total zinc consumption + 25%)

Soil Chart (PDF)

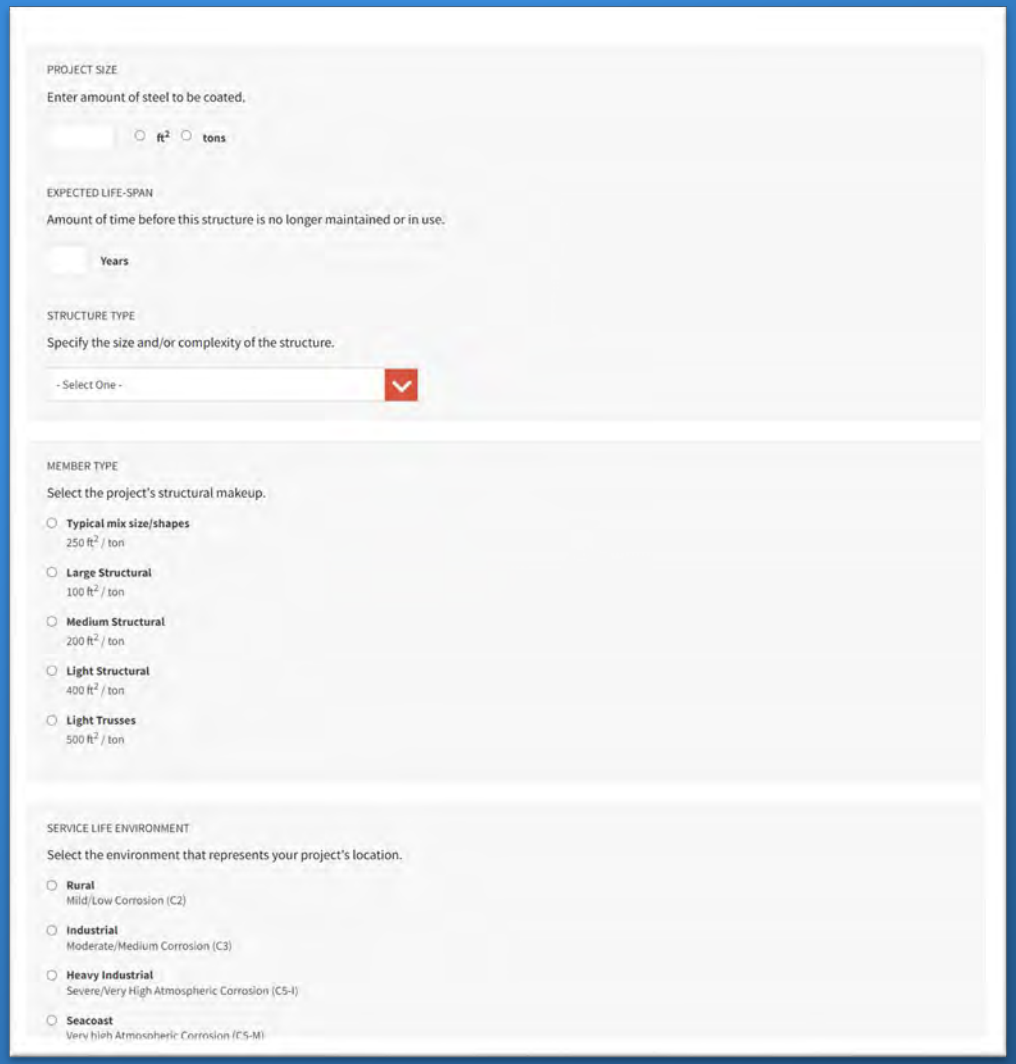


Life-Cycle Cost Calculator

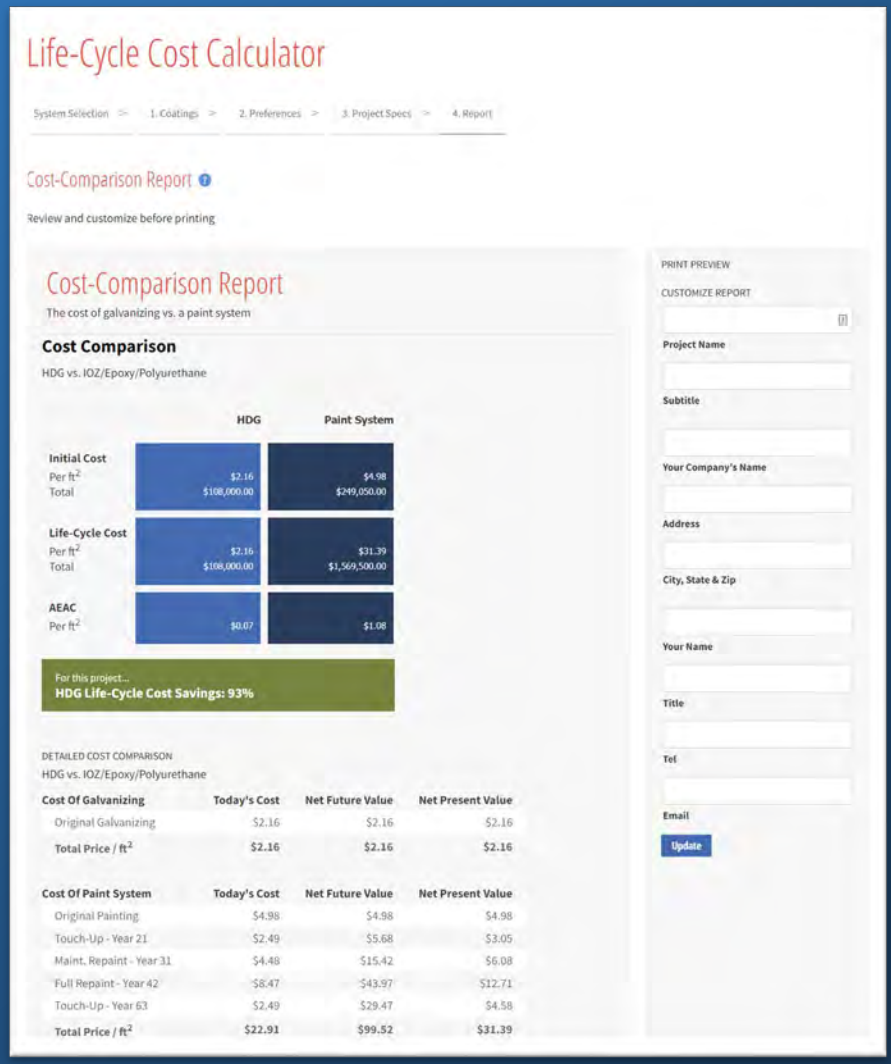
- Life-Cycle Cost Savings
  - Total cost throughout project life
  - Includes maintenance costs and time value of money (interest/inflation)
  - Often HDG initial cost IS life-cycle cost
- Life-Cycle Cost Calculator to ASTM A1068



LCCC: Inputs



LCCC: Reports



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STRUCTURAL DESIGN

STEEL TYPES & SIZE | MITIGATING DISTORTION | CONNECTIONS

OGDENSBURG-PRESCOTT BRIDGE REHAB

Ogdensburg, NY | 2021

442 tons – Main span bridge decking, structural steel floor beams and stingers

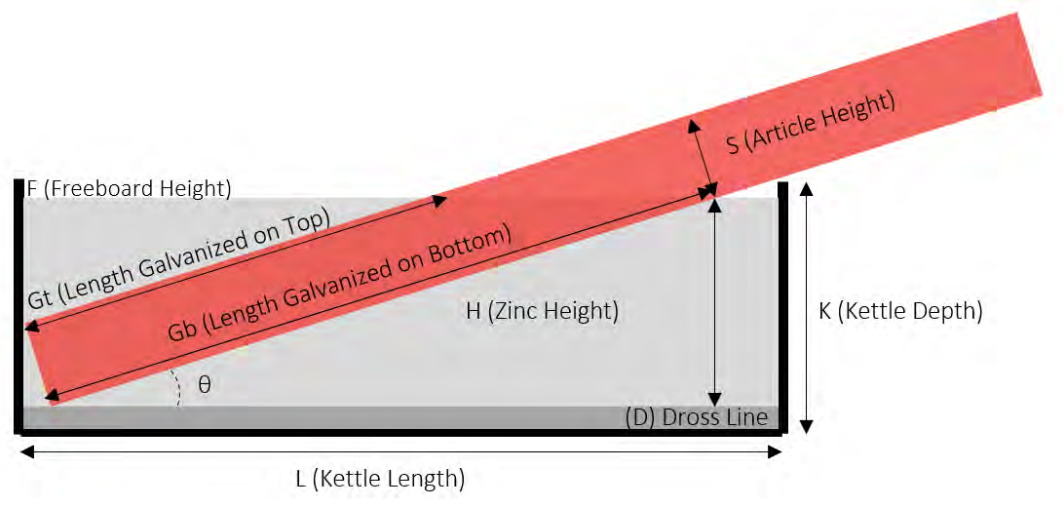
Material Considerations

- Galvanizing temperatures: no change in steel properties (i.e. chemistry, tensile strength, yield strength, or micro-structure)
- AISC prohibits hot-dip galvanizing of some high performance steels thermally treated to enhance strength
  - ASTM A709/A709M HPS 70W and HPS 100W
- High tensile strength steels (> 150 ksi)
  - Risk of hydrogen embrittlement; use alternative surface preparation methods
  - Consult ASTM A143

Material Handling at the Galvanizing Plant

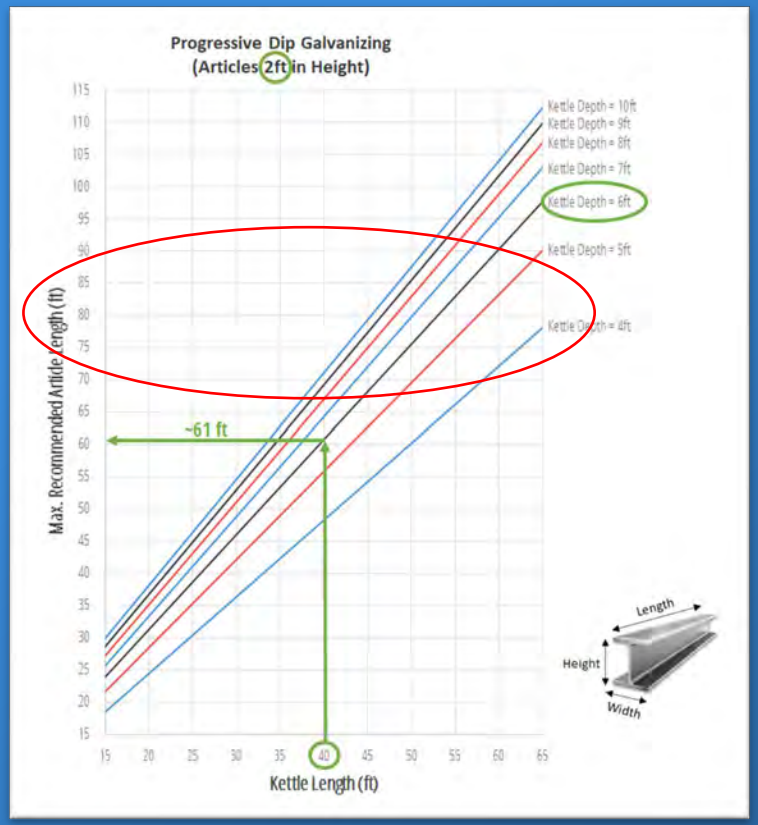
- Average kettle length in North America is 40 feet; some are 50-60 feet
- Design in modules to fit kettle size; consider progressive dipping for large items
- Galvanizers use hoists, cranes, and baskets for small items
  - Provide temporary/permanent lifting points to facilitate handling and avoid unsightly marks.
- **Consulting with galvanizer ensures design compatibility**
- For large items, ensure weight does not exceed max load capacity of handling equipment

Progressive Dipping

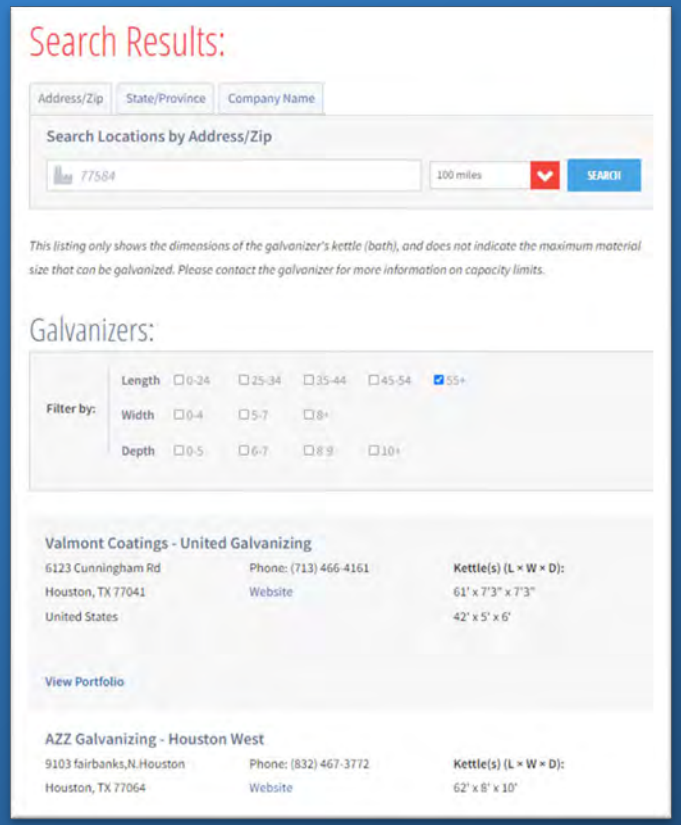


- Depends on:
  - Kettle dimensions
  - Part dimensions
  - Material handling capabilities (layout, cranes)
- Managing Expectations:
  - Overlap line appearance and roughness
  - Uneven heating
  - Increased susceptibility to warpage

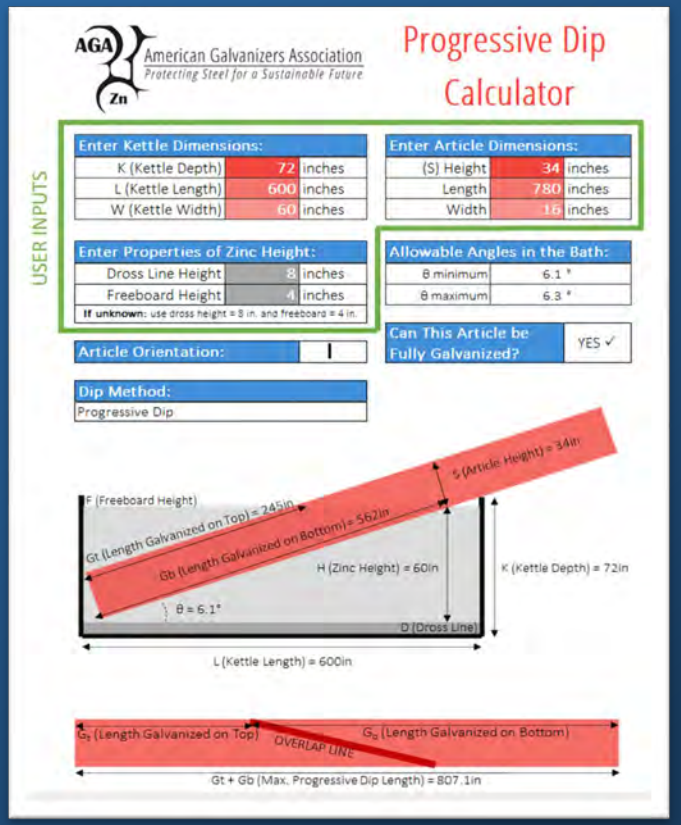
AGA Resources for Progressive Dipping



Galvanizer Locator
(sort by Kettle Size)



Progressive Dip Charts



Progressive Dip Calculator

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Jesup Bridge

Jesup, IA | Installed in 2013 – Galvanized beams, diaphragms, W-beam rail, bolts and rebar.

Winter 2013

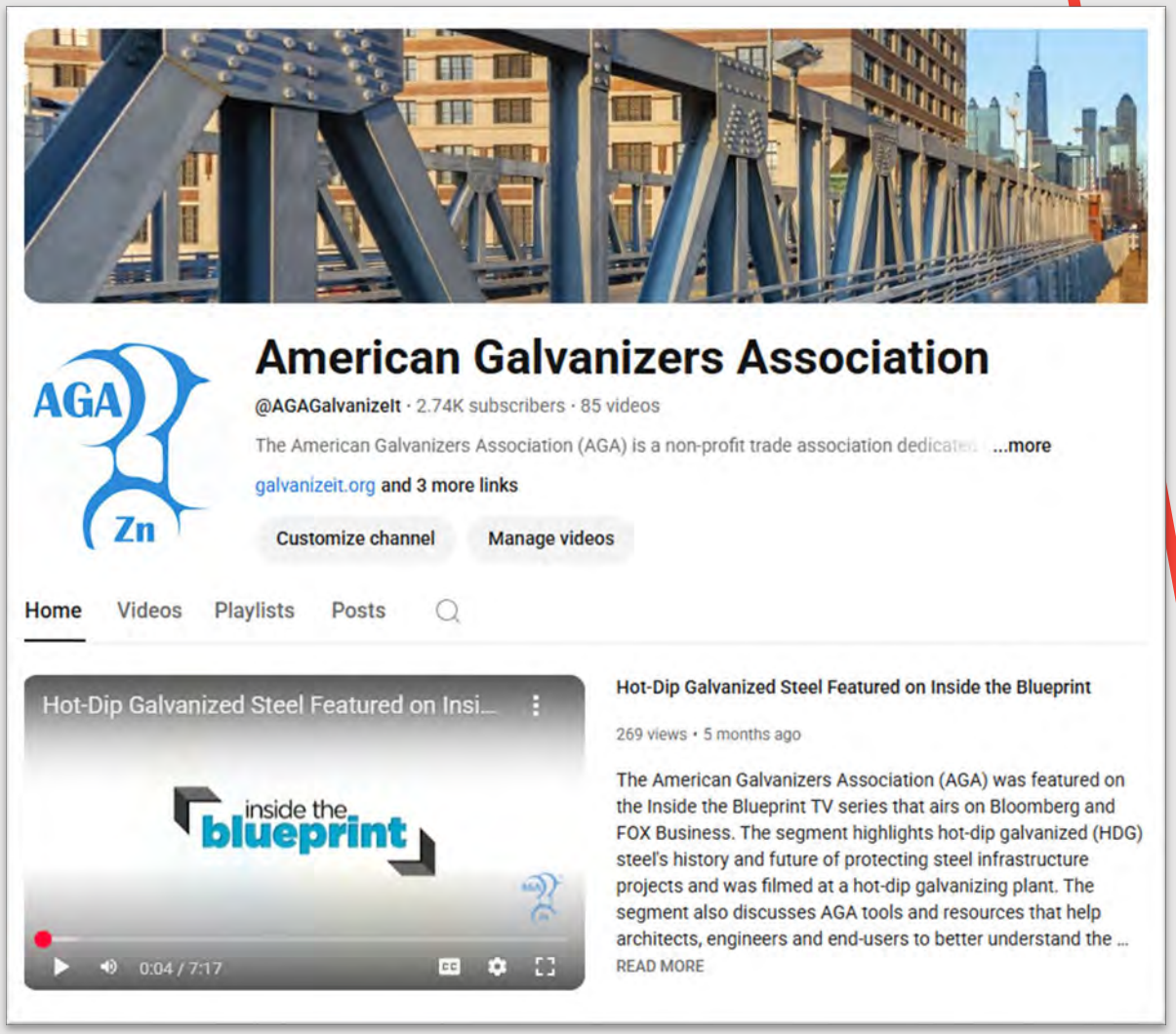
Spring 2024

- Initially, the progressive dip lines had a dark appearance and rough texture compared to the surrounding coating appearance, but after 10 years of weathering, the progressive dip line softened greatly as the zinc patina developed and provided a matte-gray color.

Options for Long Spans

- Hybrid zinc coating systems (HDG + TSZ metallizing) for mixed-size projects
  - TSZ for large, accessible steel articles / HDG for steel articles that fit in kettle
    - Maximize cost efficiency
    - Leverage superior protection of zinc coatings
- Galvanize smaller components (cross frames, splice plates, etc.)

YouTube Channel



- Interviews with architects, engineers and other end-users to get their take on how HDG has performed
- At least 10 years of service
- Riviere Cochon Gras Bridge
  - https://www.youtube.com/watch?v=iJ7qXkV6WDI&t=25s
- Buffalo Creek Bridge
  - https://www.youtube.com/watch?v=JpSJ4hi7r-w
- Irondequoit Bay Seasonal Bridge
  - https://www.youtube.com/watch?v=bEhkHevhbJw&t=1s
- Stearns Bayou Bridge
  - https://www.youtube.com/watch?v=3FoA7GOlHGk
- HDG Reinforcing Steel in Concrete
  - https://www.youtube.com/watch?v=NN-BeG4JbII

Inspection

- Steel inspected after galvanizing to verify conformance to specs
- Visual inspection with naked eye
- Coating thickness checked by magnetic thickness gauge
- Inspection of HDG Steel Products Guide
- AGA Online Inspection Course
- Download free Inspection App
  - galvanizeit.org/mobile

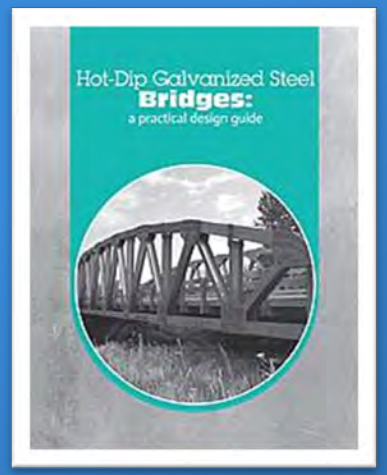
Download on the App Store

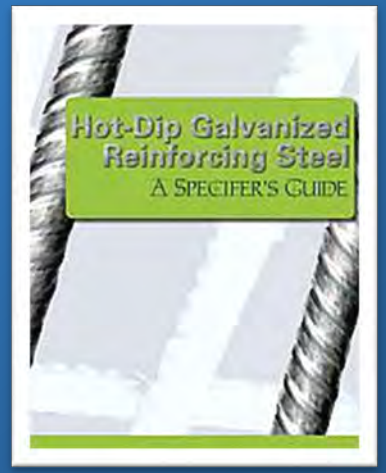
GET IT ON Google Play

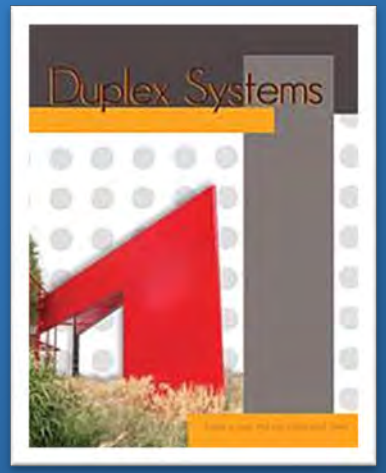
Inspection of HDG Products Guide (PDF)

Publications

More than 40 pubs available | Download free PDFs online







- Bridge Specific Publications
- Hot-Dip Galvanized Steel Bridges: A Practical Design Guide
- Hot-Dip Galvanized Reinforcing Steel: A Specifier's Guide
- Duplex Systems: Painting over HDG
- Inspection of Hot-Dip Galvanized Steel Products
- Hot-Dip Galvanizing for Sustainable Design

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Galvanize It! Seminars

- **Live Webinars**
  - 2-4 a month
  - Live Q&A
  - galvanizeit.org/webinar
- **On-Demand Course**
  - Over 12 course available
- **Lunch & Learn**
  - US and Canada Only

COLLABORATION & COLLECTIVE EFFORTS

PARTNERING ORGANIZATIONS

HILTON COLLEGE STATION, TX REMODEL

College Station, TX | 2023

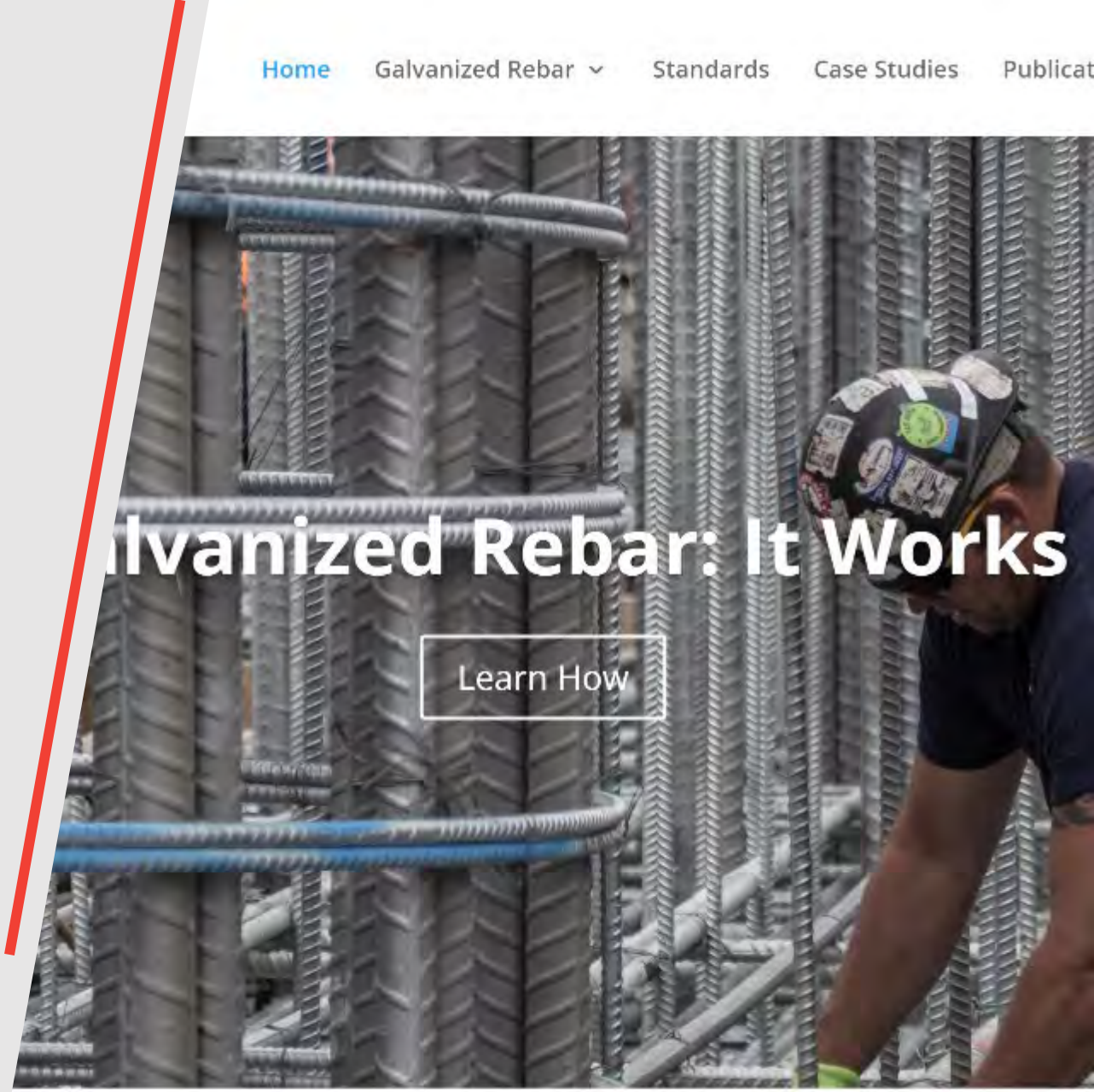
170 tons – Columns, Braces, Sun Shades

Short Span Steel Bridge Alliance (SSSBA)

- Established in 2012
  - AISI, NSBA, Professors, Bridge Manufacturers, County Engineers
- Target: Bridges up to 140 feet
  - County/Local “off system” bridges
  - Size Limitations & Headaches reduced
- Results
  - Press-Brake Tub Girder/Folded Plate
  - Galvanizing “preferred” solution

Rebar Focus Group

- AGA Subcommittee focused on growing the HDG rebar market
- Dedicated website for galvanized rebar information
  - Performance, Mechanical Properties, Field Handling
  - Standards
  - Case Studies
  - Publications
  - FAQs
- **galvanizedrebar.com**

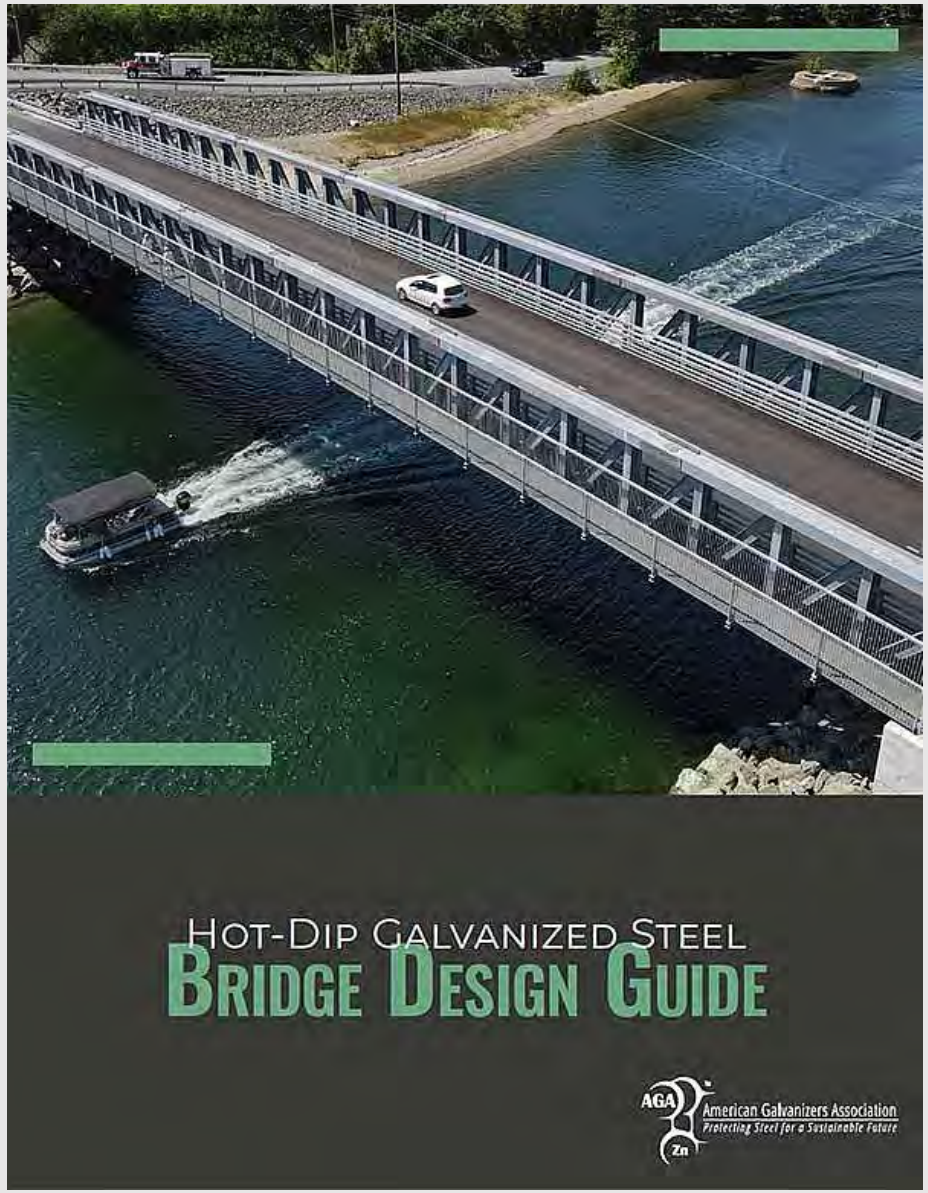


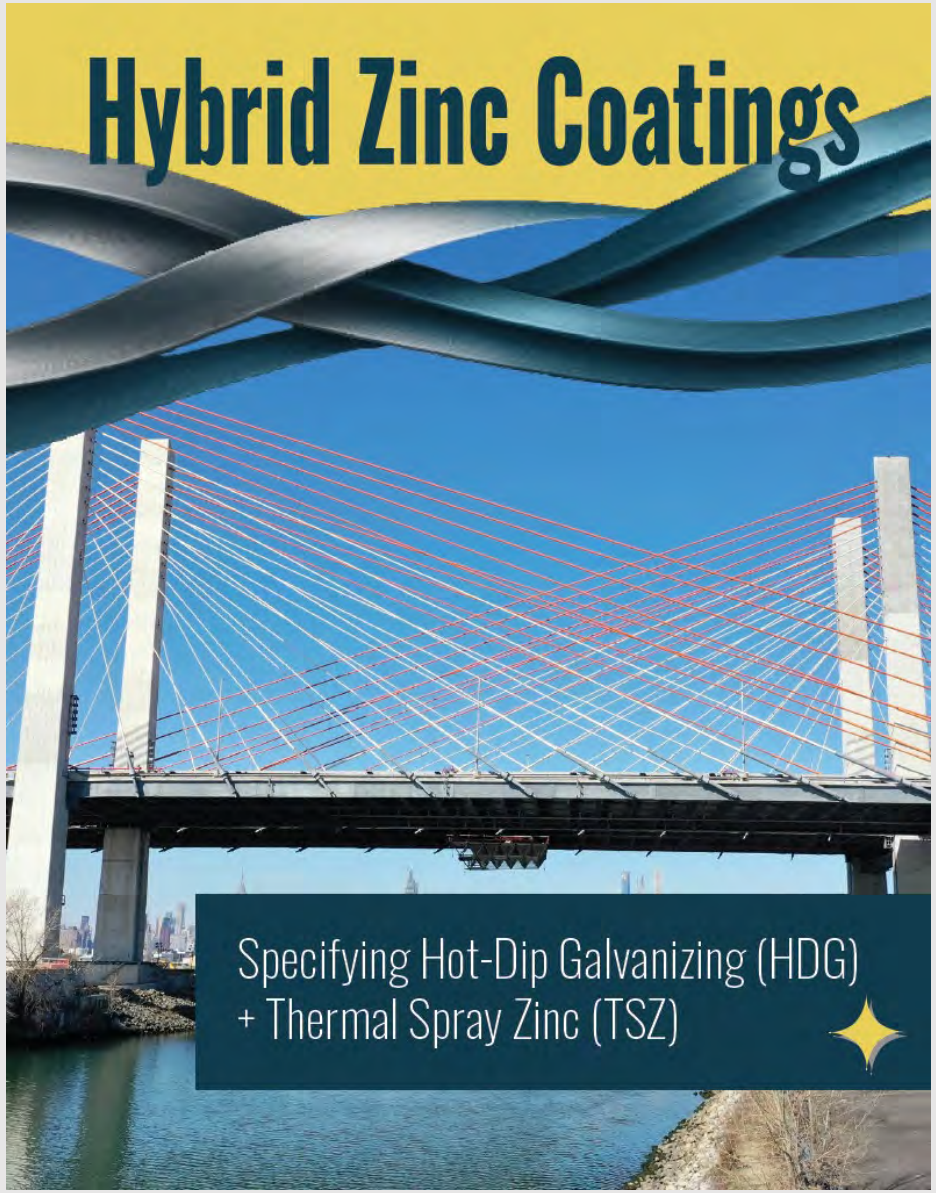
Bridge Resources

- Push back on increased marketing for Uncoated Weathering Steel (UWS)
  - Bridge Washing calculator (coming soon)
  - Demonstrate the maintenance costs for UWS previously marketed as no maintenance
  - HDG Bridge Design Guide (English)
    - Mirror the comprehensive NSBA guide on UWS
    - Translation to Spanish pending more members

Hot-Dip Galvanized Steel Bridge Design Guide

- A comprehensive guide covering best practices, design considerations, performance expectations, and maintenance strategies for galvanized steel bridges.
- Intended for engineers, owners, fabricators, and detailers, it serves as a trusted, go-to resource for hot-dip galvanized (HDG) bridge applications.





Hybrid Zinc Coatings Guide

- Introduces the Hybrid Zinc Coatings guide, helping specifiers effectively combine HDG and thermal-spray zinc (TSZ) on bridge projects.
- Establishes the first formal framework for using HDG and TSZ together, outlining key benefits and best practices.
- Includes real-world case studies demonstrating successful hybrid coating applications.

FIXING ACCESS TO RURAL MISSOURI (FARM) BRIDGE PROGRAM

Missouri | 2023

USACE FORT WINGATE BRIDGE REPLACEMENT

Gallup, NM | 2022

52 tons – Press-brake-formed steel tub girder: 8 beams weighing 12,600 lbs. each

GOVERNOR MARIO M. CUOMO BRIDGE

Tarrytown, NY | 2017

59,600 tons – Channels, conduit supports, walkway safety rail, overhead sign structures, walkway supports, rebar, drain scuppers and gratings

STEARNS BAYOU BRIDGE

Ottawa County, MI | 1966

250 tons – Rail panels, and tube rail

SUMMARY

QUESTIONS?

GALVANIZEIT.ORG

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Protecting Steel for a Sustainable Future

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